The Engineering Geologist

THE GEOLOGICAL SOCIETY OF AMERICA

NEWSLETTER OF THE ENGINEERING GEOLOGY DIVISION OF THE GEOLOGICAL SOCIETY OF AMERICA

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Chairman's Message

As I write this, the summer is more than half over and although I have left undone some things I ought to have done, the business of the division goes on with a great deal of help from many willing workers.

Several action items have transpired since publication of our April newsletter. The Burwell Committee has, for the first time in the history of the award, selected a person from outside North America as recipient of the Burwell Award. Dr. Nicholas R. Barton of the Norwegian Geotechnical Institute has been selected as the tenth recipient of the award for his paper "The Shear Strength of Rock and Rock Joints," which appeared in the *International Journal of Rock Mechanics and Mining Sciences* in 1976. Dr. Barton will be at Toronto to receive the award, and I hope that many of you will attend the division's annual dinner to greet him.

San Francisco, Chicago, Minneapolis-St. Paul, Edmonton, New York, Toronto, Kansas City, and Washington will be featured in our symposium on "Geology and Space Beneath Cities" at the Toronto meeting. Robert F. Legget has with great effort put together a blue ribbon group as perhaps only he could. The symposium will be on Monday morning (after a Sunday evening Management Board session), October 23, 1978, Ballroom Centre, Sheraton Centre Hotel. We will share a technical session with Environmental Geology on Monday afternoon, October 23, Cinema I, Sheraton Centre Hotel, and we will have our annual dinner on Monday evening, October 23, Room A, Royal York Hotel. The division reception will be held in the Toronto Room from 6:30–7:30 p.m., preceding the annual dinner. Several field trips at the Toronto meeting will be of special interest to engineering geologists. This will be the first time in several years that field trips relating specifically to engineering geology are being conducted at an annual meeting of GSA.

The symposium on "Academic Training of Engineering Geologists" to be presented at the 1979 meeting at San Diego has grown by the addition of the Association of Engineering Geologists as a third co-sponsor. Co-chairmen will be Richard H. Jahns for EGD, James V. O'Conner for NAGT, and Martin L. Stout for AEG.

At its May meeting, the GSA Council confirmed our nomination of John B. Ivey to serve on the ASCE-GSA-AEG Joint Committee on Engineering Geology. John takes the place of Harry F. Ferguson who has served as one of our representatives on the committee almost since its inception. The division owes a great debt to Harry for his long faithful service in this capacity. I hope he will become even more involved with the division's activities.

One final item is worthy of your attention. The draft of the review volume on "Nuclear Power Plant Siting" is now in the hands of the GSA Science Editor. We have requested that this and future review volumes return to the book size, cloth-bound format. While we recognize that this may add to the cost, we feel that the physical longevity of this format over the larger paperback format is desirable and more appropriate in view of the fact that these volumes always seem to be on the geological "best seller" list. Your feelings on this matter are solicited.

I will look forward to seeing many of you in Toronto.

Richard W. Galster
Chairman, Engineering Geology Division

19th U.S. Symposium on Rock Mechanics

The 19th Symposium on Rock Mechanics was held May 1–3, 1978, at Lake Tahoe, Nevada, and was sponsored by the Mackay School of Mines, University of Nevada. Preceding the symposium, the U.S. National Committee for Rock Mechanics held its annual meeting.

The symposium was attended by more than 200 mining engineers and geologists concerned with surface and underground excavation, earthquake hazard reduction, and the interpretation and application of hydraulic fracturing. Principal symposium session topics were hydraulic fracturing, probabilistic approaches in rock mechanics, earthquakes and rock mechanics, underground excavation, fracture mechanics, and surface excavation. The recently increased interest in stress measurements using the hydrofracture technique was represented by 11 papers and 2 sessions. Geologists were involved as authors or contributed data to a majority of the 75 papers presented. Perhaps as a result of their involvement, in recent years these meetings have taken on a more applied, field-oriented aspect in contrast to dominantly theoretical or laboratory-based presentations of some earlier symposia. This greater emphasis upon the in situ behavior of natural rock masses has led to a dilemma that was expressed by several speakers; it is increasingly evident that existing rock-mechanics technology is limited by inadequate knowledge of the geologic and hydrologic properties that control rock-mass stability. Although assumptions of rock properties may hasten progress in analytical techniques, solutions so obtained do not appear in nature. However, as S. J.

Green said in the opening address, representative in situ properties are difficult to obtain because of poor rock exposures and inhomogenieties in composition, structure, and in situ stresses. Attempts at precision lead to gaps in required results.

The recent report of the U.S. National Committee for Rock Mechanics, "Limitations of rock mechanics in energy-resource recovery and development," determined that the following rock mechanics problems critically limit energy-resource recovery and development:

1. Determination and prediction of porosity, permeability, and fluid flow in situ.
2. Development of better methods to obtain shallow and deep in situ stresses.
3. Mapping of fracture patterns, particularly major fractures and faults at depth.
4. Understanding the relation of laboratory-measured quantities to in situ conditions.
5. Research to provide thermophysical and thermomechanical properties of rock, including fractured rock.
6. Improvement of the understanding of rock-fragmentation processes for increasing the effectiveness of drilling and excavation systems.

The committee assigned greatest research importance to the identification and determination/quantification of significant rock properties, particularly rock-mass discontinuities on the scale of faults, shear zones, and folds.

This year the U.S. National Committee made five Best Paper awards, which were presented by W. R. Judd:

Basic Research: H. R. Pratt, H. S. Swolfs, A. D. Black, W. F. Brace, and J. W. Handin, "Elastic and transport properties of an in situ jointed granite"

Applied Research: D. C. Banks, W. E. Strohm, Jr., R. J. Lutton, and M. De Angulo, "Study of clay shale slopes along the Panama Canal: Engineering analyses of slides and strength properties of clay shale along the Gaillard Cut"

Student (M.S. or below): Gary Couples (Rice and Texas A&M), "Stress and shear fracture (fault) patterns resulting from a suite of complicated boundary conditions with application to the Wind River Mountains"

Student (Ph.D.): A. R. Ingraffea (Univ. of Colorado), "Discrete fracture propagation in rock: Laboratory tests and finite-element analysis"

Student (Ph.D.): P. N. Sundaram (Univ. of California, Berkeley), "Water pressure and resistivity changes during stick-slip and stable sliding in direct shear of rock surfaces"

Fitzhugh T. Lee
GSA Representative, U.S. National Committee for Rock Mechanics

Earthquake studies at the Waterways Experiment Station

Research and advisory services for earthquake problems in the Corps of Engineers are largely centered at the U.S. Army Engineer Waterways Experiment Station (WES). WES also provides the Corps with publications, manuals, and training courses. The areas of work include geological and seismological studies, specification of time histories of earthquake shaking, values for recurrence, possible problems of induced seismicity from reservoir loading and fluid injection, effects of earthquake shaking on foundation soils, and the capacity of structures, chiefly major earth dams and concrete dams, to sustain shaking.

WES is contributing to current projects at the Passamaquoddy Tidal Power Project at Eastport, Maine, the Dickey-Lincoln School Dams on the St. John River in Maine, Richard B. Russell Dam on the Savannah River in Georgia–South Carolina, and Warm Springs Dam and Isabella Dam in California. Restudies are under way of the Alben Barkley Dam near Paducah, Kentucky, the Sardis Dam at Sardis, Mississippi, and Ririe Dam near Idaho Falls, Idaho. WES also is handling the geological-seismological studies for the Susitna Project in Alaska which will include two dams, one 700-ft and the other 800-ft high.

Recent WES publications of interest to engineering geologists are

State-of-the-Art for Assessing Earthquake Hazards in the United States, Miscellaneous Paper S-73-1:

Report 6. David B. Slemmons, "Faults and Earthquake Magnitude," May 1977.

Report 7. Ellis L. Krinitzsky and Frank K. Chang, "Specifying Peak Motions for Design Earthquakes," December 1977.

Report 8. Frank K. Chang and Ellis L. Krinitzsky, "Duration, Spectral Content, and Predominant Period of Strong Motion Earthquake Records from Western United States," December 1977.

Report 11. Charles E. Glass and David B. Slemmons, "Imagery and Fault Interpretation," in press.

E. L. Krinitzsky
Geotechnical Laboratory, U.S. Army Engineer Waterways Experiment Station, Vicksburg, Mississippi 39180

Short Course Engineering Geology for Geologists

or

What you've always wanted to know about engineering geology, but were afraid to ask.

The Association of Engineering Geologists, in cooperation with the Education Committee of the American Geological Institute, will offer a two-day Short Course, presenting an insider's look at engineering geology. The course will be an adjunct offering to the 21st Annual Meeting of the Association of Engineering Geologists and will be held at the Hershey Country Club, Hershey, Pennsylvania, on the weekend of October 14–15, 1978. The annual meeting will be held at the nearby Hershey Convention Center from October 16 through 21. The regularly scheduled Association of Engineering Geologists field trips will be available at no extra cost to participants in the Short Course and will be discussed as to content and implications at the course.

Engineering geology is the single discipline of our profession that makes the widest use of applied geology techniques to fully integrate geologic factors into the planning and design of engineered construction and many of the aspects of mineral and ground-water extraction and waste disposal.

The conveners of the Short Course realize that many of our compatriots in academic pursuits are called upon to teach courses in environmental and engineering geology or have experienced frustration in counseling and advising students who have expressed an interest in practicing in applied geology fields. Likewise, many "classical" geologists come into contact with engineering geologists in a variety of ways and are confronted with many of the unusual aspects of the discipline. The outstanding lineup of well-known practitioners will also afford many narrow-specialty engineering geologists a state-of-the-discipline review of engineering geology in the late seventies. Graduate students and

upperclassmen will find the Short Course an excellent introduction to applied geology.

The Short Course is designed to explore how engineering geologists function, what engineers expect of them, the theories and techniques that are used, the areas on which engineering geology focuses its attention, how the practice is conducted, the ways in which students can prepare to enter the discipline, and what can be learned from the associated field trips.

Further information is available from Alfonso F. Geiger, Chief Geologist, Engineering Division, Soil Conservation Service, U.S. Department of Agriculture, Washington, D.C. (202) 447-5858 *or* Allen W. Hatheway, Chief Geologist, Haley & Aldrich, Inc., Consulting Geotechnical Engineers and Geologists, 238 Main Street, Cambridge, Massachusetts (617) 492-6460.

The Short Course is expected to cost approximately $75, excluding room and meal costs.

ENGINEERING GEOLOGY FOR GEOLOGISTS

SECTION I – INTRODUCTION		
1. Welcome	William H. Matthews	15 min.
2. The Profession	Howard A. Spellman	15 min.
3. Course Objectives	A. F. Geiger	15 min.
4. Structure of the Course	Charles F. Withington	15 min.
SECTION II – WHAT IS ENGINEERING GEOLOGY?		
1. Keynote Speakar	Eugene B. Waggoner	1 hour
2. Professional Registration	William Cutcliffe	30 min.
3. What Engineers Expect of Engineering Geologists	Harvey Parker	1 hour
SECTION III – THEORY AND TECHNIQUES		
1. Soil Mechanics	Allen W. Hatheway	30 min.
2. Rock Mechanics	To be announced	30 min.
3. Hydrogeology	John Ferris	30 min.
4. Remote Sensing	Charles F. Withington	30 min.
5. Field Mapping for Engineering Purposes	Richard W. Galster	30 min.
6. Trench, Shaft, and Tunnel Mapping	Allen W. Hatheway	30 min.
7. An Overview of Site Investigations	Paul Fisher	30 min.
SECTION IV – APPLICATIONS		
1. Urban Geology	Albert J. Froelich	30 min.
2. Dam Site Investigations	Jerry Oodd	30 min.
3. Tunneling and Underground Structures	R. J. Proctor	30 min.
4. Power Plant Siting	Norman Tilford	30 min.
5. Waste Disposal Site Selection	Keros Cartwright	30 min.
6. New Environmental and Reclamation Restraints on Surface Mining	Frank J. Anderson	30 min.
7. Hydrogeologic Implications of Mining	Richard Parizek	30 min.
8. Erosion end Sediment	William F. Mildner	30 min.
9. Seismicity Assessments	Ellis Krinitzsky	30 min.
SECTION V – ENGINEERING GEOLOGY PRACTICE IN THE EAST		
1. Southeast	Gerald Fogle	30 min.
2. Northeast	Allen W. Hatheway	30 min.
SECTION VI – PREPARATION FOR THE PRACTICE OF ENGINEERING GEOLOGY		
1. Academic Preparation	C. C. Mathewson	1 hour
2. Applying for a Job	Raymond Throckmorton	30 min.
SECTION VII – FIELD TRIPS		
Briefings	Organizers	30 min.
SUMMARY	A. F. Geiger	30 min.

Number 11, Engineering Geology Case Histories: *Decay and Preservation of Stone*

The volume *Decay and Preservation of Stone*, edited by E. M. Winkler (Number 11 in the series of Engineering Geology Case Histories published by the Engineering Geology Division of GSA) is now available. The work is divided into three sections:

Part I. Stone Properties and Testing
Part II. Stone Weathering
Part III. Stone Preservation

The price is $8.00 for GSA members ($10.00 for nonmembers).

Mid-continent seismicity studies

Two additional studies on seismicity are now available from NTIS, Springfield, VA 22161:

1. Seismicity and Tectonic Relationships of the Nemaha Uplift in Oklahoma, by K. V. Luza, Principal Investigator; Oklahoma Geological Survey; Price $6.00 paper, $3.00 microfiche; NUREG/CR-0050 R6A.
2. Regional Tectonics and Seismicity of Eastern Nebraska, by R. R. Burchett; Nebraska Geological Survey; Price $4.00 paper, $3.00 microfiche; NUREG/CR-0053 R6A.

Both studies were prepared for Division of Reactor Safety Research, U.S. Nuclear Regulatory Commission.

Geotechnology in Massachusetts

Planning has begun for a major conference on "Geotechnology in Massachusetts," scheduled for March 1980, which will include the following topics: bedrock geology, surficial geology, hydrology, geophysics, siting criteria, rock mechanics, use of underground space, energy and the geosciences, economic geology, environmental and medical geochemistry, soils and engineering, and nearshore and offshore zones.

A variety of submissions, which may take the form of reviews, long or short papers, or ideas for panel discussion, are encouraged.

Although the first notice called for abstracts or full descriptions by September 15, 1978, those with a strong interest should promply contact Prof. Oswald C. Farquahar, Dept. of Geology and Geography, University of Massachusetts, Amherst, MA 01003.

Joint ASCE-GSA-AEG Symposium on "Capable Faulting"

A joint symposium on the topic "capable faulting" was held on November 7, 1977, in Seattle, Washington. The symposium took place on the "overlap day" between back-to-back meetings of GSA and AEG. The convener of this symposium was Robert L. Schuster of the USGS, who originally conceived this conference as the EGD's annual symposium.

The need to define capable faults and to recognize them in the field results from the requirements of regulations by the Nuclear Regulatory Commission to assure safety in the siting of nuclear electric generating stations. Nuclear plants may not be built in the vicinity of capable faults. A capable fault is characterized by:

(1) Evidence of movement within 35,000 years.
(2) Evidence that a fault has a structural coupling to a known capable fault.

(3) Evidence that seismic activity is associated with the fault which could cause
   - — movement at the ground surface along the fault trace.
   - — ground failure by liquefaction, etc.
   - — intense vibratory ground motion which would result in damage to the structure of a nuclear plant.

In the morning session, three topics were discussed which dealt with the definition and historical development of regulations. The three topics addressed were "Historical Development of Fault Terminology in Nuclear Reactor Siting," "Application and Interpretation of Appendix A, 10 CFR 100 in Nuclear Plant Site Evaluation," and "Definitions Related to Fault Activity and Nonactivity." The topics were presented primarily by those who have been personally involved, for some time, in the formulation or interpretation of such definitions, or those responsible for interpreting the adequacy of investigations to determine whether capable faults are present that affect the selection and approval of proposed sites for nuclear plants.

The morning session clearly indicated that the development of the regulations on capable faults resulted from a complicated interaction among scientists and public policy makers. Geologists, geophysicists, and engineers attempted to define, in many cases for the first time, the rational limits of geological inquiry as related to predicting future geological events. Of primary importance in the regulatory process, was the maintenance of public safety which required that the concept of "acceptable risk" be addressed in terms of technical interpretations. Geologists and engineers have been placed in the position of making the best possible interpretations of their data and communicating their interpretations effectively so that public policy making bodies aware of the limits of certainty of any projection based on these interpretions.

The afternoon session focused on field investigations, as examples, to clarify the concepts of fault activity and capability as they relate to geological practice. Speakers indicated the need for objectivity and the importance of not being overly influenced by previous geological investigations in an area. Investigations have been conducted in many areas for a variety of purposes which may not have taken into account features relevant to nuclear power plant siting. Field mapping with a minimum of preconceptions is an essential starting point.

Other topics discussed included the problems of structural design in the presence of faults, relationships between seismicity and faulting, and field studies in several parts of the USA aimed at determining the capability of fault zones.

Questions still persist. What causes seismicity in the geologically older continental areas? How can one assess the possibility of reactivation of old faults? What is the relationship between seismicity and specific geological structures?

In summary, as one person attending the symposium, the writer was left with the strong impression that the role of Earth scientists is important in supplying part of the information upon which major decisions that involve public health and safety must be based. More important than the collection of data, however, is the rational dispassionate interpretation of data which can give public policy makers a means of assessing the level of confidence that can be placed on such decisions.

William J. Mallio, *Editor*

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